INTERNATIONAL STANDARD

ISO 17892-8

First edition
2018-02

Geotechnical investigation and testing — Laboratory testing of soil —

Part 8:
Unconsolidated undrained triaxial test

Reconnaissance et essais géotechniques — Essais de laboratoire sur les sols —

Partie 8: Essai triaxial non consolidé non drainé

Reference number
ISO 17892-8:2018(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 341, *Geotechnical investigation and testing*, in collaboration with ISO Technical Committee TC 182, *Geotechnics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 17892-8 cancels and replaces ISO/TS 17892-8:2004 and ISO/TS 17892-8:2004/Cor.1:2006.

A list of all the parts in the ISO 17892 series can be found on the ISO website.

Introduction

This document covers areas in the international field of geotechnical engineering never previously standardized. It is intended that this document presents broad good practice throughout the world and significant differences with national documents is not anticipated. It is based on international practice (see Reference [1]).

Geotechnical investigation and testing — Laboratory testing of soil —

Part 8: Unconsolidated undrained triaxial test

1 Scope

This document specifies a method for unconsolidated undrained triaxial compression tests.

This document is applicable to the laboratory determination of undrained triaxial shear strength under compression loading within the scope of geotechnical investigations.

The cylindrical specimen, which can comprise undisturbed, re-compacted, remoulded or reconstituted soil, is subjected to an isotropic stress under undrained conditions and thereafter is sheared under undrained conditions. The test allows the determination of shear strength and stress-strain relationships in terms of total stresses.

Non-standard procedures such as tests with the measurement of pore pressure or tests with filter drains are not covered in this document.

NOTE This document fulfils the requirements of unconsolidated undrained triaxial compression tests for geotechnical investigation and testing in accordance with EN 1997-1 and EN 1997-2.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14688-1, *Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description*

ISO 17892-1, *Geotechnical investigation and testing — Laboratory testing of soil — Part 1: Determination of water content*

ISO 17892-2, *Geotechnical investigation and testing — Laboratory testing of soil — Part 2: Determination of bulk density*

ISO 17892-3, *Geotechnical investigation and testing — Laboratory testing of soil — Part 3: Determination of particle density*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
cell pressure
pressure applied to the cell fluid

3.2
deviator stress
difference between the applied vertical total stress and the horizontal total stress at the mid height of the specimen

3.3
undrained shear strength
equal to one half of the deviator stress at failure in the unconsolidated undrained triaxial compression test

3.4
failure
stress or strain condition at which one of the following criteria are met:

— peak deviator stress;

— a specified deformation criterion if a peak deviator stress has not been achieved, e.g., 15 % vertical strain.

4 Symbols

A_i initial cross-sectional area of the specimen

A_{cor} cross-sectional area of the specimen during shear

a cross-sectional area of the piston if an external load cell is used

c_u undrained shear strength

D_m initial internal diameter of membrane (before it is placed on the specimen)

E_m elastic modulus for the membrane, measured in tension

f factor relating the vertical strain to the specimen volumetric strain

H_s initial height of the specimen prior to shearing ($=H_i$-ΔH_i)

H_i Initial height of specimen after preparation

h distance from the top of the top cap to the mid height of the specimen

P vertical load reading

t_m initial thickness of the unstressed membrane

V_i initial volume of the specimen after preparation

W gravity force acting on the sum of the deadweight hanger (if used), the piston, the top cap and one half of the soil specimen

γ unit weight of the cell fluid

ΔH_i height change prior to shearing

ΔH_s height change during shearing

$(\Delta\sigma_v)_m$ correction to vertical total stress due to the membrane

ε_v vertical strain

$(\varepsilon_v)_m$ vertical strain of the membrane

σ_c cell pressure at the mid height of the specimen

σ_h horizontal total stress at the mid height of the specimen

σ_v vertical total stress at the mid height of the specimen

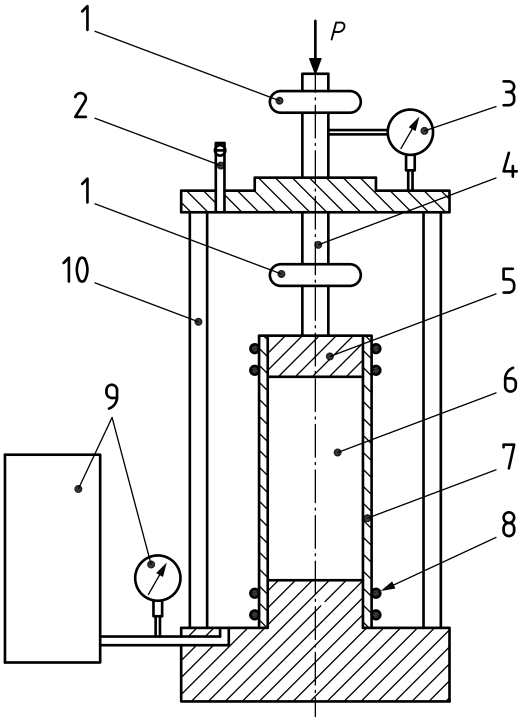
ΔV specimen volume change (with reduction in volume being a positive numerical value)

5 Apparatus

5.1 General

The apparatus shall undergo regular maintenance, checks and calibration as specified in Annex A.

A schematic diagram of a typical apparatus for triaxial compression testing is shown in Figure 1.



Key

1 alternative positions for load measuring device
2 air bleed
3 vertical displacement measuring device
4 piston
5 top cap
6 soil specimen
7 rubber membrane
8 O-rings
9 device for control and measurement of cell pressure
10 triaxial cell
P vertical load

Figure 1 — Schematic diagram of a typical unconsolidated undrained triaxial apparatus

5.2 Triaxial cell

5.2.1 The triaxial cell shall be able to withstand the applied cell pressure without leakage of cell fluid out of the cell. Transparent cells should be used where possible.

5.2.2 The sealing bushing and piston guide shall be designed such that the piston runs smoothly with minimal friction and maintains alignment.

5.2.3 The material of the top cap and the pedestal and the connection between the top cap and the piston shall be such that their deformations are negligible compared to the deformations of the soil specimen.

5.2.4 The diameter of the top cap and of the pedestal should normally be equal to the diameter of the specimen. Specimens with diameters smaller than the diameter of the end caps may be tested provided cavities under the membrane at the ends of the specimen can be avoided.

5.2.5 The vertical stress applied to the specimen due to the weight of the top cap should not exceed 2 % of the estimated undrained shear strength of the specimen or 1 kPa, whichever is the greater.

5.3 Confining membrane

5.3.1 The soil specimen shall be confined by an elastic membrane which effectively prevents the cell fluid from penetrating into the specimen.

NOTE Membranes with an elastic modulus of around 1 400 kPa have been found to be suitable.

5.3.2 A confining membrane that gives a correction on the estimated undrained shear strength of less than 10 % at failure should be used (see 7.4).

If rubber membranes are used, membranes with following properties should be used:

— unstretched diameter between 95 % and 100 % of specimen (after being stored in water);

— thickness not exceeding 1 % of the specimen diameter.

5.3.3 O-rings or similar, used to seal the confining membrane to the top and to the pedestal, shall have dimensions and elastic properties such that the confining membrane is firmly sealed to the top cap and to the pedestal.

5.4 Cell pressure system

The device for applying the cell pressure shall be capable of maintaining a stable pressure within 1 kPa or 1 % of the absolute pressure, whichever is the greater.

5.5 Load frame

5.5.1 The load frame shall be able to provide a range of rates of vertical strain as required for the test (see 6.4.1). The actual rate applied shall not fluctuate more than 10 % of the intended value. The movement of the platen shall be smooth without vibration such that fluctuations do not occur in the test results.

5.5.2 The stroke of the load frame shall be more than that required for the test. A value of 30 % of the specimen height is normally suitable.

5.6 Measuring devices

5.6.1 Load measuring device

The accuracy of the vertical load measuring device, in the range 20 % to 100 % of the capacity of the device, shall be 1 N or 1 % of the actual value, whichever is greater. The device should be insensitive to changes in horizontal forces or bending moments, and to changes in temperature or cell pressure during a test, unless the performance is sufficiently stable that the effect can be corrected.

The capacity of the load measuring device should be chosen so that the failure load is at least 20 % of its capacity.

NOTE Class 1 load measuring devices to ISO 7500-1 meet this accuracy requirement.

5.6.2 Pressure measuring device

The cell pressure measuring device shall be sufficiently accurate to permit the determination of total cell pressure to 1 kPa or 0,5 % of the full range of the device, whichever value is the greater.